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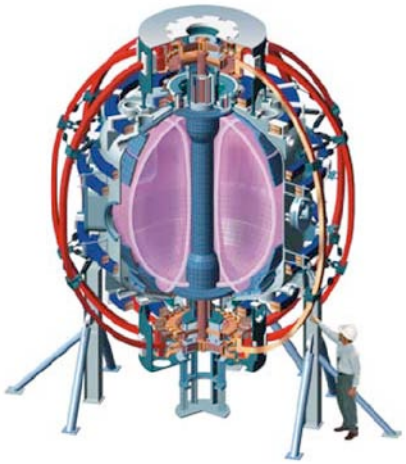
NSTX Perspective on FY06 Particle Control Decision and ALIST Module

R. Kaita
for the NSTX Group



Plasma Facing Components Meeting
December 06-08, 2004
Livermore, CA

PPPL PRINCETON PLASMA PHYSICS LABORATORY

Outline

1) Definitions of Module Concepts

2) NSTX Position on Module Concepts

3) NSTX Boundary Physics Timeline

Definitions of Module Concepts

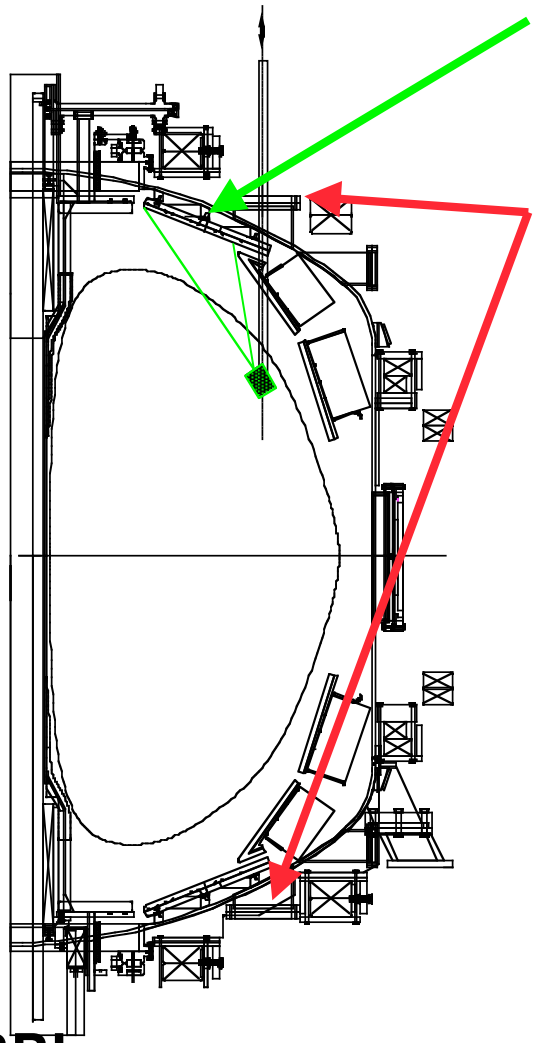
[0) Lithium Pellet Injection]

1) Module A (Phase I): Lithium deposition on graphite

2) Module A (Phase II): Lithium deposition on less permeable substrate

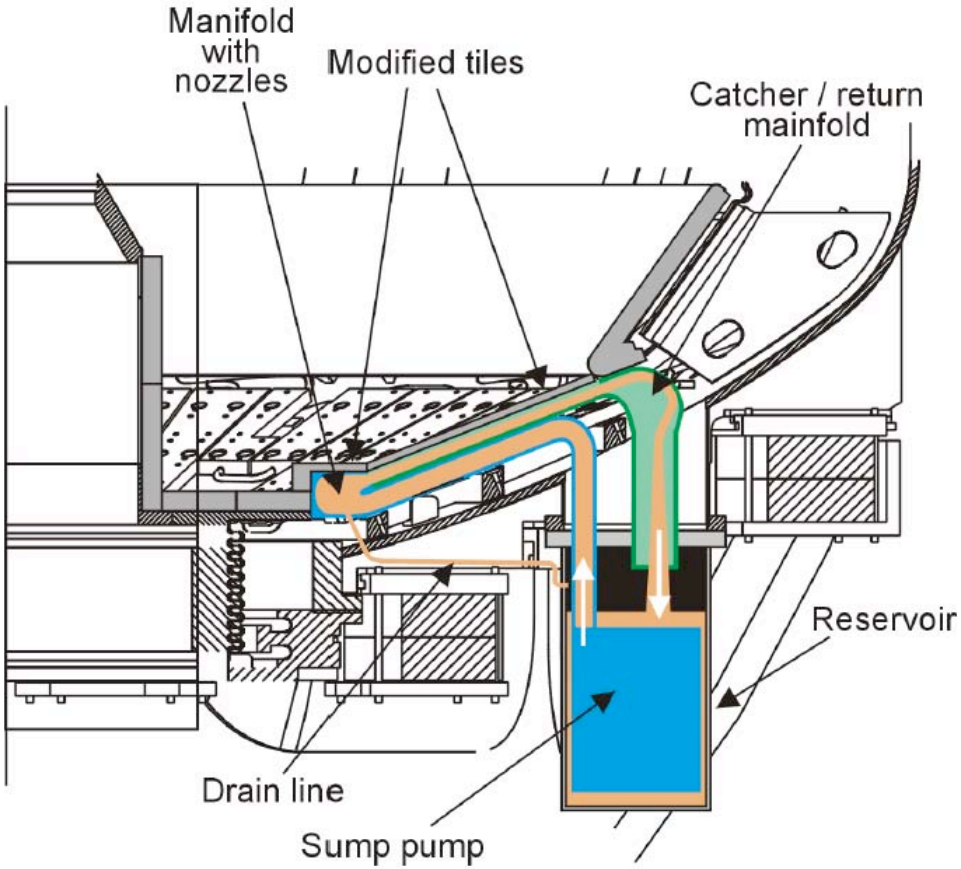
3) Module B: Flowing liquid lithium module

Module A Concept



- Evaporator to be inserted between shots
  - Heat load during plasma liquefies lithium on divertor surfaces
- Port covers and gate valves installed on upper and lower dome ports for retractable coating system
  - Retractable probe successfully tested with insertion of supersonic gas injector during FY04 NSTX operating period
- CDX-U will test coating system in early FY2005
  - Lithium evaporator undergoing tests in “off-line” chamber
- Operation planned for FY06 NSTX run

Module B Concept



- Module area ~ 1 m^2
- Flow liquid lithium at ~7-12 m/s to avoid evaporation at full power

Concept courtesy of C.Eberle, ORNL

NSTX Position on Module A

- NSTX committed to Module A (Phase I)
  - Lithium evaporation on carbon part of baseline program
- Commitment to Module A (Phase II) contingent on Phase I results
  - Effect on recycling and edge plasma parameters observable but transient with carbon substrate
  - Results consistent with intercalation of lithium in carbon

NSTX Position on Module A - continued

- Conditions under which Module A (Phase II) may be unnecessary
  - Success with carbon may remove requirement for impermeable substrate
  - Replacing divertor PFC's may be difficult if cost must be covered under NSTX budget
    - » More economical alternative being investigated by Plasma Processes Inc. - small business specializing in high temperature materials and advanced thermal spray processes for rocket engines
    - » Funded under Phase I SBIR to investigate plasma spraying of molybdenum on metallic substrates
    - » Resulting porous surface can increase lithium inventory

NSTX Position on Module B

- NSTX plans to move decision point from FY06 to FY07
  - Key motive was delay in VLT-supported PFC effort on Module B
- Delay in liquid metal MHD experiments impacts decision point
  - SNL LIMITS data on liquid lithium jets needed to determine feasibility for NSTX
  - Tight schedule for ITER PFC tasks created budget pressure that will delay LIMITS program by at least six months
- Earlier decision point scheduled prior to existence of other options
  - CDX-U experiments suggested feasibility of lithium evaporator (Module A)
  - Results from Module A on NSTX required to determine need for Module B

NSTX Position on Module B - continued

- Responsibility for cost of Module B an issue
  - Original understanding was that VLT would pay for module fabrication and NSTX would cover interface costs
  - US commitment to ITER suggests that funding for VLT to cover both Module B and ITER TBM very unlikely
- Suggest that M. Ulrickson still address Activities Certification Committee (ACC)
  - Importance of safety suggests that concerns should be addressed well before decision point for implementing Module B on NSTX
  - Discussion could be scheduled during next NSTX PAC meeting on January 20-21

Boundary Physics (DRAFT)

Plasma Operations	FY 05	FY 06	FY 07

- ● - Available
- ● - Base
- ● - Revised
- ■ - Incremental
- ◈ - Decision Point

Wall Conditioning (Gas/plasma Boronization, Between-shot GDC)

- ● Li Pellet Injector
- ● Lithium Evaporator
- ● Hot-boronization
- ● Between-shots boronization
- ● Moveable GDC probe

Power / Particle Control

- ● Divertor IR Camera (ORNL)
- ● Fast IR Camera (ORNL)
- ◈ **Divertor Cryopanel / Liquid Li Module**
- ■ Divertor Probe
- ■ Vert. Divertor Bolometer
- ■ Horiz. Divertor Bolometer
- ■ Div. Spectrometer

Fueling (In-board gas Injectors)

- ● Supersonic Gas injector
- ■ Pellet injector in "suitcase" (ORNL)
- ■ CT injector Lab. Test